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CONTENTS

SETCHELL, WILLIAM ALBERT. *Zostera marina latifolia*: ecad or ecotype? 1
SCOTT, FLORA MURRAY. On certain fossil cones from the Pacific Coast... 7
RYDBERG, PER AXEL. Notes on Fabaceae—VIII. *Hamosa*..... 13
GLEASON, HENRY ALLAN. Four new Melastomataceae from Peru..... 25
BARTRAM, EDWIN BUNTING. Notes on *Mielichhoferia*..... 31
WILSON, CARL LOUIS. Adventitious roots and shoots in an introduced weed..... 35
RICE, MABEL AGNES. The haustoria of certain rusts and the relation between host and pathogene (PLATES 1–9)..... 63
TAYLOR, ARAVILLA MEEK. Some ecological habitats in the Longleaf Pine Flats of Louisiana..... 155
KARLING, JOHN SIDNEY. Variations in the mature antheridium of the Characeae: A descriptive study in morphogenesis (PLATES 10–14). 187
BUSH, BENJAMIN FRANKLIN. The glabrate species of *Tilia*..... 231
PICKETT, FERMEN LAYTON, and LEWIS A. THAYER. The gametophytic development of certain ferns: *Polypodium vulgare* var. *occidentale* and *Pellaea densa* (PLATES 15–17)..... 249
GLÜCK, HUGO. A new *Sagittaria* from Florida: *Sagittaria Kurziana*.... 257
GOLDSTEIN, BESSIE. The x-bodies in the cells of dahlia plants affected with mosaic disease and dwarf (PLATES 18–20)..... 285
REED, GEORGE MATTHEW, MARJORIE SWABEY, and LAURA ALMA KOLK. Experimental studies on head smut of corn and sorghum (PLATES 21–25)..... 295
RUSBY, HENRY HURD. Additions to the genus *Munnozia* R. & P..... 311
RYDBERG, PER AXEL. Notes on Fabaceae—IX. *Hamosa* (concluded).... 321
THARP, BENJAMIN CARROLL. *Commelinantia Pringlei* (PLATES 26, 27)... 337
MATZKE, EDWIN B. An analysis of the orthic tetrakaidecahedron..... 341
HEIN, ILLO. Studies on morphogenesis and development of the ascocarp of *Sphaerotheca Castagnei* (PLATES 28, 29)..... 383
HIMMEL, WALTER JOSEPH. A contribution to the biophysics of *Podophyllum* petioles (PLATES 30–31)..... 419
TRELEASE, WILLIAM. Additions to the genus *Phoradendron*..... 471
MCDONALD, CLINTON C. A study of seed development in three species of *Erigeron* with special reference to apogamy (PLATES 32, 33)..... 479
WALLACE, RAYMOND HAROLD. The production of intumescences in Transparent apple by ethylene gas as affected by external and internal conditions (PLATE 34)..... 499
BARTON, LELA V., and SAM F. TRELEASE. Stimulation, toxicity, and antagonism of calcium nitrate and manganese chloride as indicated by growth of wheat roots..... 559
ASHE, WILLIAM WILLARD. *Magnolia cordata* and other woody plants.... 579
THOMAS, HARVEY EARL. Kieffer pear seedlings and fire blight resistance. 583

GLEASON, HENRY ALLAN. Studies on the flora of northern South America —X. 603
SCHAFFNER, JOHN HENRY. Extraordinary sexual phenomena in plants . . 619
SHREVE, FORREST. Soil temperatures in redwood and hemlock forests . . . 649
FERGUSON, MARGARET CLAY. A cytological and a genetical study of *Petunia*—I. (PLATES 35, 36) 657
INDEX TO AMERICAN BOTANICAL LITERATURE, 39, 173, 263, 349, 453, 543, 587, 631, 665
INDEX TO VOLUME 54 691

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Errata

Page 82, line 10, for '*Pinus sylvestrus*' read '*Pinus sylvestris*.'
Page 82, line 13, for '*Frittilaria*' read '*Fritillaria*.'
Page 82, last line, for 'aporophytic' read 'sporophytic'.
Page 83, line 2, for '*Entyloma Nympheae*' read '*Entyloma Nymphaeae*'.
Page 129, lines 4 and 10, for '*Acanthostigma parasitica*' read '*Acanthostigma parasiticum*'.
Page 141, line 22, for '*Uromyces houstoniatum*' read '*Uromyces houstoniatus*'.
Pages 188, 192, 213, 216, 217, 227, 229, for '*Lamprothamnus alopercoides*' read '*Lamprothamnus alopecuroides*'.
Page 233, after line 21, insert, coördinate with 'Leaves creno-serrate; summer-shoots tomentose', 'Leaves serrate or dentate, never creno-serrate; summer-shoots glabrous or tomentose'.
Page 238, line 4 from bottom, for '*Tilis*' read '*Tilia*'.
Page 245, line 6, for '*T. Michanxii*' read '*T. Michauxii*'.
Page 246, line 2, for '*T. Carolinians*' read '*T. Caroliniana*'.
Page 247, add foot-note '[6] Ashe, Bull. Charleston Mus. 32. 1925'.
Page 252, line 2 from bottom, for '*P. virides*' read '*P. viridis*',
Page 312, line 21, for '**M. giganteum**' read '**M. gigantea**'.
Page 325, lines 12, 35, and 36, for '*Nuttallii*' read '*Nuttallianus*'.
Page 327, line 12 from bottom, for '*A. austrina*' read '*H. austrina*'.
Page 332, line 2, for '*H. asprella*' read '*H. asperula*'.
Page 335, line 5, for '*Experanzae*' read '*Esperanzae*'.
Page 337, lines 9 and 21, for 'Monterrey' read 'Monterey'.
Page 338, line 25, for '*Commelina banghalensis*' read '*Commelina benghalensis*'.
Page 505, line 7 from bottom, for '*Conocephalus ovalus*' read '*Conocephalus ovatus*'.

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CONTENTS

Zostera marina latifolia: ecad or ecotype? . WILLIAM ALBERT SETCHELL 1
On certain fossil cones from the Pacific Coast . FLORA MURRAY SCOTT 7
Notes on Fabaceae—VIII. Hamosa . . . . . PER AXEL RYDBERG 13
Four new Melastomataceae from Peru . . . . . H. A. GLEASON 29
Notes on Mniaceae . . . . . EDWIN B. BARTRAM 31
Adventitious roots and shoots in an introduced weed . . . . . C. L. WILSON 35
INDEX TO AMERICAN BOTANICAL LITERATURE 39

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Zostera marina latifolia: ecad or ecotype?

WILLIAM ALBERT SETCHELL

Zostera marina L. is undoubtedly a widespread species, ranging through many seas and many waters of different temperature relations, both as to range and as to degree, as well as to variety of seasonal maxima and minima. Ostenfeld gives a wide distribution for *Zostera marina* L. in both the north Atlantic (including the Mediterranean) and in the north Pacific oceans.[1] On the Pacific coast of North America, he gives its distribution as extending from southern California to Alaska.[2] There is, however, a discontinuity in the distribution of the *Zostera* variants on the west coast of North America which is puzzling and worthy of note. To the north (Unalaska, in the Bering Sea, and probably elsewhere in Alaska) what seems to be the typical plant similar to that of eastern North America and Europe occurs as it does also in the southern portion of the range (at least at San Diego, California), but between these two divisions of the coast (from southern Vancouver Island to Santa Barbara and probably to San Pedro) occurs a larger plant, with broad leaves of an aspect different from the usual form of Europe and of the Atlantic coast of North America.

The first to call attention to the broad leaved plant of the Pacific Coast of North America was Thomas Morong (Bull. Torrey Club **13**:160. 1886) who named it *Zostera marina* var. (?) *latifolia*. The type specimen was collected cast up on the shore at Santa Barbara, California. He described the leaves as 5–12 mm. wide, 10–13 nerved with 7–8 striae between the nerves, and the fruits 4–5 mm. long by 3 mm. thick and with about 25 longitudinal ribs. Morong later on (Mem. Torrey Club **3**: 63. *pl. 71*. 1893) raised his variety to a species, *Zostera latifolia* Morong, and extended his description. At this time, he described the

[1] Ostenfeld, C. H. Sea grasses. Report on the Danish Oceanographical Expeditions 1908–1910 to the Mediterranean and Adjacent Seas **2**^{K2}: 16. 1918.

[2] Ostenfeld, C. H. On the geographic distribution of the sea grasses. Proc. Roy. Soc. Victoria **27**: 188. 1914.

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root stalks as being stout and 8–10 feet long, the leaves as 2–4 feet long, and the fruit as having 20–25 longitudinal ribs.

In 1891, however, Sereno Watson (Proc. Amer. Acad. **26:** 131) described two new species of *Zostera* from the Pacific coast. The one, *Z. oregana* Watson, has slender root-stalks, narrow leaves (1.5–2 lines broad and rather faintly 3-nerved), spathes without a terminal appendage, and fruit with 16 longitudinal ribs. Morong (*loc. cit.*, p. 62) thinks that this species of Watson is *Z. marina*, that is as not belonging to his *Z. latifolia*. It is interesting to note here that Morong describes *Z. marina* as having 20 longitudinal ribs on the fruit and very correctly suggests that the spathe of Watson's *Z. oregana* has simply lost its terminal appendage, as often happens in older specimens of *Z. marina*. The type came from the mouth of the Columbia River.

The *Zostera pacifica* Watson is founded on the same general set of specimens as Morong's *Z. marina* var. *latifolia* and agrees in general, as to description, with Morong's statement. Watson, however, states that the 'seed' is 'not evidently striate, but appearing under the microscope very finely transversely striolate.' No type is designated, but specimens are quoted ranging from Puget Sound to Santa Barbara.

An examination of Watson's type specimens in the Gray Herbarium convinces me that both his species are the same and belong to the familiar broad leaved plant of the middle region of the Pacific Coast of North America. *Zostera oregana* Watson is an older flowering stem whose spathes have lost the terminal segment, and *Z. pacifica* Watson shows longitudinal striae of the proper number (about 20) on the immature seeds (still enclosed in the utriculoid ovary wall). It seems clear that both are closely related to *Zostera marina* L. and may be designated as *Z. marina* var. *latifolia* Morong, or simply as the *latifolia* form of *Z. marina*.

Since the *latifolia* form is frequent in the San Francisco Bay region (although not conveniently accessible to those who live in Berkeley), I have attempted to obtain as considerable collections and data as possible. The chief assistance has been obtained through Mr. Harold E. Parks and Miss Monica Dietrich. Mr. Parks, particularly, has collected stages in development throughout several years in connection with observations on the

temperature of water and air, and Miss Dietrich has examined the various materials collected on the central Pacific coasts, and compared her results with those obtained from an examination of a great amount of material collected through successive years on the Atlantic coast of North America from Beaufort, North Carolina, north to the fjords on the Greenland coast in the neighborhood of Godthaab.

The results of Miss Dietrich's examinations may be summarized in the following comparisons:

Character	*Atlantic*	*Pacific*	*No. of plants*
Length of flowering plant	1.5–4 feet	3–10 feet	100+
Number of branches of flowering plant	1–5	1–21	100+
Width of leaves	5/32 inches	5/16 inches	100+
Number of nerves in leaves	3	5–7	100+
Longitudinal ribs on seed coat	16–18	17–22	100+

From the summary of Miss Dietrich's examination of somewhat over 100 plants from each coast of North America, it seems to be clearly indicated that the differences between *Zostera marina typica* and *Z. marina latifolia* may be considered quantitative, and probably clearly so. In breadth (and length also, although no measurements are given) as well as in number of nerves, the leaves of the *latifolia* form exceed (with slight overlapping) those of the typical form. The same is true of the number of internodes (usually 7 in f. *typica* and much over that and up to 30 or thereabouts in f. *latifolia*). In number of branches of the flowering shoot, f. *latifolia* much exceeds f. *typica*. These might be expected as within the limits of variation in the species, but the excess of longitudinal ribs on the seed coats of f. *latifolia*, which barely overlap with those of f. *typica*, seems to indicate a possible qualitative difference as well, being at least a quantitative difference of another type than length and breadth relations, although the number of internodes and number of nerves, and consequent opportunity for greater length and number of branches, may possibly also be thought of as qualitative.

As far as I can determine, however, the characters of number or size are the only characters in which f. *latifolia* differs from the f. *typica*. Furthermore, there are occasionally observed, outside the range of typical f. *latifolia*, individuals with broader leaves, suggesting other plant dimensions similar to it, but such individuals have neither been noted frequently nor carefully studied.

The occurrence of such a striking variant as the *latifolia* form or variety, along as extended a coast as that from Vancouver Island to Santa Barbara, leads to the question of environmental conditions and particularly those of climatic relations, in the case of both f. *typica* and f. *latifolia*. The two forms of *Zostera marina* exist under very similar edaphic and biotic complexes, so far as is evident, and the climatic complex differs chiefly in the temperature factor. It is this factor and its possible influence that presents itself for investigation in the two cases.

I have already indicated (Science **56:** 575–577. 1922) the results of a general study of the temperature relations of *Zostera marina*. The awakening of its dormant vital activities occurs at approximately 10° C. Its vegetative processes proceed with the gradual but comparatively rapid, rise of the temperature of the water until at 15° C. the leaves are well expanded, the erect stem of the season is well developed, and the flowers are formed. As the temperature rises over 15° C., anthesis occurs (protogynous), pollination takes place, and fruit is formed and matured. If the temperature rises above 20° C. and remains there even for a few days, the erect stem of the year dies and with its own segments of rhizome breaks away from the rest of the prostrate portion of the plant and floats, scattering its fruits as it decays, depositing them mostly in protected shallow muddy areas where later they are grubbed up by ducks and geese, whose crops during the spring migration are frequently full of them. Along the Atlantic coast of North America the seasonal temperature range for the water for that portion known to be inhabited by f. *typica*, goes well below 10° C. in the late winter months, and up to or well above 20° C. in the later summer and early autumn months. Even in the most northern portion of the range, the inner fjords running in from Godthaab, Greenland, we may suspect the temperature of the water rising well above 15° C., since the eel grass comes into anthesis, although the few temperatures at our disposal do not indicate so high a temperature. There are complete records for f. *typica* and its temperature relations for two years from Beaufort, North Carolina, and Woods Hole, Massachusetts made by the United States Bureau of Fisheries, and fairly complete records for the season of greatest growth, anthesis, and fruiting from the coasts of New Jersey, outer coast at Newport, Rhode Island, and inner Narragansett Bay region at Lee's River,

Massachusetts. There are suggestive records from Mt Desert Island, Maine, and St. Andrews, New Brunswick. More details of these will be given in a later paper. The general trend of all these observations along the Atlantic Coast of North America indicates that the entire growing period at each of the localities mentioned is about two and not over three months. At Beaufort, North Carolina, these are the months of March and April; on the sheltered inland waters of New Jersey, probably April and May; at Lee's River, Massachusetts, May and June; extending at Woods Hole, Massachusetts, from May into early July; on the outer coast at Newport, Rhode Island, June and July; and on the Maine coast, July and August.

Observations on the f. *latifolia* in beds at Paradise and Kyle coves on the Marin County shore of the Bay of San Francisco, carried out by Mr. H. E. Parks, indicated a much slower rise of temperature from about 9° C. in February to about 18° C. from April to late September (varying from 15° C. to 18° C.) and occasionally going up possibly to nearly 20° C. when influenced by seepage or outflow from shallow lagoons, declining soon after the last week of September to 12° C. and then gradually to 10° C., reaching 9° C. and 10° C. the last of January.

Growth from leaf buds starts promptly at about 10° C. (early February) and at a little above that plentiful seedlings were obtained (early February). At about 15° C. anthesis begins, but the ovaries appear to blast if the temperature does not rise. This is generally about the first week in April. In the warmer parts of the bed (those most subject to seepage of warm water from a lagoon) the anthesis proceeded rapidly and fruits set, but in the colder portions of the bed (washed by an outer current) anthesis was backward or the young fruits blasted. From the temperatures of the waters, it may be presumed that similar relations hold throughout the range of f. *latifolia*.

The temperature relations of f. *latifolia* are seen to be very different from those of f. *typica*, the rest of the environmental complex being, so far as can be estimated, very similar if not identical. The temperature never rises above 20° C., the upper temperature limit of activity for both forms, and goes only a degree or so below 10° C., its lower limit of activity. The rise of temperature is somewhat slower in the case of the waters inhabited by f. *latifolia*, and seemingly the development of the

plant as a whole, and particularly of the fruits, proceeds more slowly and through a period several times as long as is the case in f. *typica*.

It seems possible, therefore, that the quantitative differences which separate f. *latifolia* from f. *typica* may be due directly or indirectly to the peculiar temperature relations of its environment, and that f. *latifolia* may simply be an ecad or environmental form induced by the different intensity and duration variables of the temperature factor of its environment. Whether it be an ecad in the reversible sense of Clements, (Plant Physiology and Ecology, pp. 192, 193, 1907) or an ecotype in the sense of Turesson (Hereditas **4**: 172. 1923) can of course only be determined by culture from seed or by transplant experimentation, a test not at present possible for me to carry through. These methods alone are likely to determine whether any difference in the genetic constitution exists between the two sets of forms.

The variation in morphological characters between the two varieties of *Zostera marina* is clearly associated with a difference in intensities, rapidity of rise and fall, and seasonal variation in the temperature factor, and this general relation is certainly suggestive of some causal connection between the environmental factor and the quantitative morphological differences, but as to whether there has been a genetic change or simply a variable genetic response must be left for future study.

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BERKELEY.

On certain fossil cones from the Pacific Coast

FLORA MURRAY SCOTT

Widespread and dominant as are the Conifers in the vegetation of the present day, of their early history comparatively little is known. The discovery of gymnosperm wood in various degrees of petrifaction points to a relative fixity of anatomical structure. Of the reproductive organs of the ancestral forms, however, we can as yet say very little. Looking at a present day Conifer, it is of course obvious that the cone of such a forest tree runs but a very slender chance of being conveyed entire to a near-by stream, thence onward to a convenient lake, an area of sedimentation, and of fossil formation. Against such a possibility also there militates the cone habit of certain forms. The cone of the genus *Pinus*, for example, opens to shed its seeds, but remains as a rule, attached to the parent branch for a varying length of time. In the genus *Abies*, on the other hand, the cone disintegrates entirely, scales and seeds being shed simultaneously. Interpreting the past in the light of the present, the paucity of the fossil record appears therefore to be less remarkable. The fossil cones, to be presently described, belong to the geological collection of Stanford University. They were placed at my disposal by Dr. J. P. Smith. To Dr. Smith, and to Dr. LeRoy Abrams of the Department of Botany, I wish to express my very sincere thanks for criticism and assistance in the identification of the following forms.[1]

1. *Pinus muricata* Don. The Santa Clara formation of the Coast Range, consisting of coarse gravels, sands, sandy clays, locally lignitic, of fresh water origin (Branner, 3) in addition to a varied fauna, preëminently recent in character, has also yielded a unique Pliocene flora. To the list of plants which Hannibal (5) has described from this formation, there may be added the gymnosperm *Pinus muricata* Don (collected by L. H. Dougherty).

Embedded in the grayish yellow sandstone of the plant beds at Portola was found the base of a pine cone, completely car-

[1] Photographs of all the specimens discussed in this paper, at best very difficult subjects, were submitted with the manuscript for publication, but at the suggestion of the editor were withdrawn, as being inadequate for reproduction without much re-touching.—EDITOR.

bonized, in form somewhat flattened, but otherwise perfectly preserved. The cone was unfortunately abruptly broken off, the outcrop on the cliff-face having been cut back during road construction. On splitting the sandstone, the carbonized fragment became loosened and dropped out, leaving a perfect mould of both sides. The specimen was 2.5 cm. long and was flattened to a breadth of 4. 5 cm. Judging from the general outline of the part preserved, the cone was originally 5–6 cm. in length.

In its general appearance, its asymmetry, and the elongated, sharp-pointed, and still unopened scales, it coincides entirely with the description of the cone of *Pinus muricata*.

> Cones 5–7 cm. long, . . . unsymmetrical, . . . by the much enlarged outer scales, which are prolonged into prominent knobs armed with a stout elongated spine, remaining closed for many years. . . . (Abrams, 1).

The asymmetry is peculiarly well seen in the mould of the two sides of the fossil, and while the actual spine is slightly less obvious on the tip of the carbonized scale, yet its position is perfectly apparent throughout.

The genus *Pinus* in North America dates at least from Jurassic, the leaves of *Pinus Nordenskiöldi* Heer being described from strata of that age in Douglas County, Oregon (Knowlton, 6). Thereafter, by the time of the laying down of the Cretaceous (Raritan and Magothy) of the Atlantic states, *Pinus*, to judge from the numerous species then in existence, was already a successful genus, and has so continued until the present day.

The Coniferae, as a whole, form the main vegetation of the Western Divide of the Coast Ranges of Western America. While certain species range throughout the entire forest belt, there are others which are notably restricted in occurrence, and of such is the present *Pinus muricata*.

> **Pinus muricata**, a maritime species of the Transition and Upper Sonoran Zones, most abundant and best developed along the coast from Inglenook, Mendocino County, to Point Reyes, California, forming an almost continuous belt. Southward occurring in small, widely separated groves, Point Pinos Ridge near Monterey, Pecho Mountains, San Luis Obispo County, and Santa Cruz Island; re-appearing again in a modified form (var. *Anthonyi* Lemmon) between Ensenada and San Quentin, Lower California, and on Cedros Island (Abrams, 1).

Such discontinuity in distribution probably indicates that *Pinus muricata* is a waning species; that, at one time, when its occurrence throughout the Coast Ranges was uninterrupted

(a probable hypothesis supported by the finding of the present specimen) it possibly occupied a more important place in Coastal Forest vegetation.

2. *Pinus* sp. (collected by O. E. Paine). It has already been remarked that the genus *Pinus* dates at least from the Jurassic period. Of the fossil Coniferae it is one of the most widely occurring genera. On the Pacific Coast it is repeatedly recorded from British Columbia (Penhallow, 8) and from California (Knowlton, 6). The majority of the fossils, however, consist of leaf and branch impressions. Cones are but rarely reported.

In the Miocene deposits thirteen miles north of Santa Barbara, California, were found the two cones considered here. Of these, one is fairly complete. The fossil is conical in shape and markedly asymmetric. It measures about 10 cm. in length and 5.5 cm. in diameter. Before calcification it had already undergone considerable decay and no traces of the axis remain. In its stead the hollow central space is lined with irregular and somewhat fibrous calcite.

In asymmetry, in the form of the scales, thin at the base, and expanded distally into 'prominent transversely flattened knobs' (Sargent, 9), the cone appears to resemble fairly closely that of *Pinus attenuata* Lemmon, although the diagnostic spines of this species are not preserved.

The present distribution of *Pinus attenuata* Lemmon extends from Oregon to the San Bernardino mountains, so that, if the identification with *Pinus attenuata* should hold, the discovery of the fossil indicates the very prolonged continuation of a successful species.

3. *Pseudotsuga* sp. In marked contrast to the genus *Pinus*, the genera *Pseudotsuga* and *Abies* (to be presently discussed) are almost entirely absent from the fossil record.

The Miocene of British Columbia (Penhallow, 8) and of Alberta (Knowlton, 6), the Pliocene of the Santa Cruz mountains, California (Hannibal, 5), and the Pleistocene of Humboldt County, California, and of Mystic Lake, Montana (Knowlton, 6) have yielded the only traces of this, today, very widespread genus.

The present specimen, a finely preserved cone, was found in the Oligocene (?) or Lower Miocene (?) of Nitinat Lagoon, Vancouver Island (loc. N. P. 142: collected by H. Hannibal).

The cone is completely petrified and has been sectioned and

polished. It is elongated-elliptical in shape and measures 7 cm. in length and 3.5 cm. in diameter. Springing almost at right angles from the central axis there arise bract, thin and flattened scale, and seed. In section the cone bears a striking resemblance to that of the present day form, *Pseudotsuga mucronata* Sudw. This species today ranges from the Skeena River as far south as Northern Mexico (Sargent, 9).

4. *Abies* sp. (N. P. 253: collected by H. Hannibal.) Of the geological history of the genus *Abies*, widespread today throughout the northern hemisphere, and abundant along the Pacific Coast, remarkably little is known. From the Pleistocene of Ontario, Canada, *Abies balsamea* (Linne) Miller is reported, and from the Kenai formation of Alaska, *Abies* sp. (Knowlton, 6). From the Trias onwards there occur numerous *Abies*-like twigs and leaves, in a more or less imperfect state of preservation. These bear a sufficient resemblance to the genus *Abies* to warrant the name *Abietites*. The traces consist mainly in leaf impressions. The lower Cretaceous (Arundel and Patapsco) of Maryland (Berry, 2) has however yielded numerous cones of *Abietites macrocarpus* Fontaine. These again are but poorly preserved.

For the rest a few isolated specimens of *Abietites Ernestinae* Lesquereux (7) and of *Abietites* sp. (Fontaine 4) appear to form the sum total of the remains of *Abies*-like cones.

That complete cones of *Abies* do not occur as fossils is doubtless due to the fact that they do not fall from the tree when mature. The cone-scales fall off separately, leaving on the branch the upright axis.

The present specimen from the Oligocene (?) or Lower Miocene (?) of Vancouver Island is therefore of interest.

The cone measures about 10 cm. in length and 5 cm. in diameter. Though but roughly preserved (in dull brown friable sandstone) the elliptical form, the blunt apex, with wide, closely imbricated scales, are unmistakably diagnostic of the genus *Abies*.

In general appearance it resembles fairly closely the species *Abies concolor* Lindley, which today ranges from the Rocky Mountains of Colorado to the Coast Ranges of California and northwards to Oregon.

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LOS ANGELES

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Notes on Fabaceae—VIII

PER AXEL RYDBERG

HAMOSA

The genus was constituted by Medicus, (Vorl. Churpf. Phys. Ges. **2**: 376. 1787), and based on *Astragalus hamosus*, *A. glyciphyllus*, and *A. trimestris*, of which the first must be taken as the type. This is an annual European species with narrow arcuate pod, subterete in cross-section, perfectly 2-celled, with valves of a firm texture. *A. trimestris* evidently belongs to the same group, but the pod of *A. glyciphyllus* is quite different. The American species known in 1866, were included by Gray in his section MICRANTHI, except *Astragalus succumbens*, which was made a section by itself, *A. tener* of which the pod was unknown, and *A. Lindheimeri*, which was misplaced.

Keel not beaked.
- Perennials with a cespitose rootstock or caudex.
  - Corolla 1–2 cm. long (rarely 7–10 mm. long); pod linear or narrowly oblong, rather abruptly acute at each end, spreading.
    - Plant villous or pilose; calyx cylindric-campanulate, the tube longer than the teeth.
      - Pod glabrous, strongly flattened... 1. SUCCUMBENTES
      - Pod pubescent, less strongly flattened..... 2. MALACAE
    - Plant strigose or glabrate; calyx campanulate.
      - Low, pulvinate-cespitose, acaulescent, silvery plants; wings 2-lobed. 3. SCAPOSAE
      - Taller, leafy-stemmed, usually canescent or glabrous plants; wings entire..... 4. TRIQUETRAE
  - Corolla 5–7 mm. long, flowers in dense racemes; pod broadly oblong or lance-oblong, gradually acute, reflexed..... 7. HARTWEGIANAE
- Annuals with few-flowered racemes and mostly narrowly linear pods..... 5. LEPTOCARPAE

Keel produced into a porrect beak..... 6. ACUTIROSTRES

1. SUCCUMBENTES

This group was constituted by Dr. Gray as a section of *Astragalus*. It is characterized by the following features: low

and stout cespitose perennials, with pilose stems amd leaves, short dense racemes, rather large flowers, fully 2 cm. long, cylindro-campanulate pilose calyx, the lobes being less than half as long as the tube, broad, linear-oblong, slightly falcate, glabrous pods, 3–4 cm. long, 5 mm. broad, deeply sulcate on the lower suture, compressed, inverted Y-shaped in cross-section, membranous, sessile. It is represented by only one species, which Jones united with the MALACAE.

1. **Hamosa succumbens** (Dougl.) Rydb. *Astragalus succumbens* Dougl.; Hook. Fl. Bor. Am. **1**: 151. 1831. *Astragalus dorycnioides* Dougl. (D. Don, Gen. Hist. **2**: 258. 1832) is generally regarded as a synonym of this. The description agrees fairly well, except that the calyx is described as 'smooth.'

OREGON: *Howell*, in 1880; Alkali, *Howell*, in 1882; Pendleton, *Griffiths & Hunter 6;* without locality, *Wilkes Expedition 1018;* Baker City, *Nevius* in 1875; Warner Valley, *Eggleston 6985, 6989.*—WASHINGTON: Walla Walla, *Douglas; Lyall* in 1860; *W. Brandegee 719;* Klickitat Co., *Cotton 1342;* Umatilla, *Cusick 586;* Kluck, *Howell*, in 1879.—CALIFORNIA: Butte County, *Eggleston 7335.*

2. MALACAE

This group was proposed by Jones as a section MALACI of *Astragalus*. *A. malacus* and *A. Andersonii* had been included by Watson as anomalous species of the section MICRANTHI, which Sheldon remodeled and renamed as EREMITICUS. As constituted by Jones the section was very unnatural, containing besides *A. malacus* and *A. Layneae*, also *A. succumbens* mentioned above, *A. Parryi*, and *A. feensis*. *A. Parryi* has no close relationship to *A. malacus*. Nor do I think that *A. feensis* should be included Gray placed *A. Andersonii* next to *A. malacus*, but Jones placed it in HAMOSI next to *A. Congdoni*. The group consists of stout cespitose perennials, with rather middle-sized flowers about 1.5 cm. long, rather broad, oblong or linear, falcate pods, with long loose pubescence, slightly sulcate on the lower suture and narrowly obcordate in cross-section.

Calyx black-hairy; pod 2–4 cm. long; corolla purple or tipped with purple.
  Pubescence spreading; pod moderately arcuate, acute or short-acuminate..... 2. *H. malaca*

Pubescence appressed or ascending.	
Pod strongly arcuate, long-acuminate, 3–4 cm. long	3. *H. Layneae*
Pod straight or slightly arcuate, 2–2.5 cm. long, abruptly acute	4. *H. Minthorniae*
Calyx white-hairy; pod less than 2 cm. long; corolla white or ochroleucous; pubescence villous	5. *H. Andersonii*

2. HAMOSA MALACA (A. Gray) Rydb. In this species the calyx-tube is comparatively long and in that respect the flower approaches that of the genus *Xylophacos*. The fruit, however, is that of a typical *Hamosa*, except that it is broader and long-pilose. Jones (Rev. Astrag. 227. 1923) made *Astragalus obfalcatus* a variety of *A. malacus*, and it may be so regarded.

NEVADA: Carson City, *C. L. Anderson 26, 307, 285; Shockley 353;* Eagle Valley, *Stretch 152, 224;* Trinity Mountains, *Watson 259;* Washoe County, *Heller 9698a, 9574;* Empire City, *Jones 3838;* Virginia City, *Bloomer*, in 1863; Mica Springs, *Jones 5036a;* Carson City, in 1897.—CALIFORNIA: *Lemmon 63;* Lassen County, *Mrs. Bruce 2214;* Owens Valley, *Horne; Jones*, in 1897; San Bernadino Mountains, *Parish 1275* (?); Modoc Co., *Mrs. Manning*, in 1907; Howey Lake, *Brandegee*, in 1892; Mojave Desert, *Grinnell*, in 1907; Calico, *Lemmon*, in 1884.—OREGON: Malheur County, *Leiberg 2090;* Stein Mountain, *Howell;* Warner Valley, *Eggleston 6989, 6985;* McDowell Creek, *7052.*—IDAHO: Weiser, *Jones 6226.*

3. **Hamosa Layneae** (Greene) Rydb. *Astragalus Layneae* Greene, Bull. Calif. Acad. **1**: 156. 1885. This species is evidently most closely related to the preceding, though the habit, pubescence of the leaves, and shape of the pod remind much of those of *Xylophacos amphioxys*, for which it has been mistaken. *Heller 7669* has larger and less hairy leaflets and larger flowers about 2 cm. long. The specimens are in flower only. Bigelow's specimens were described as *Astragalus Fremontii* var. (Pacific Railroad Rep. **4**: 80. 1857).

CALIFORNIA: Mojave Creek, *Bigelow*, on Whipple Expedition; Darwin, *Jones*, in 1897; San Bernadino County, *Heller 7669;* Lee Mine, Inyo County, *S. W. Austin;* Mojave Desert, *Parish 1273.*—NEVADA: Rhyolite, *Heller 9668;* Las Vegas, *Gooding 2283*; Gold Mountain, *Purpus 5939.*

4. **Hamosa Minthorniae** Rydberg sp. nov. Perennial, prob-

ably cespitose; stems low, strigose and striate; leaves erect, 5–10 cm. long; stipules ovate, 7–8 mm. long; leaflets 11–17, obovate, 8–15 mm. long, 4–6 mm. wide, silky-canescent, rounded at the apex; peduncles 8–12 cm. long; racemes 6–10 cm. long; bracts lanceolate or lance-linear, 5–6 mm. long; calyx black-hairy, the tube 5–6 mm. long, the teeth subulate, 2 mm. long; corolla white, with a purple-tipped keel; banner obovate, 15 mm. long; wings much shorter, the blades oblong-falcate, with a large rounded auricle; keel-petals still shorter, broadly lunate, rounded at the apex; pod oblong, straight or slightly arcuate, 2–2.5 cm. long, 4 mm. thick and wide, shaggy-pilose, abruptly acute, obcordate in cross section.

NEVADA: Vicinity of Pioche, Lincoln County, April 24, 1909, *Maud Minthorn 77* (type in herb. N. Y. Bot. Gard., duplicate in Univ. California); Kyle Cañon, *Tidestrom 9612*.

5. **Hamosa Andersonii** (A. Gray) Rydb. *Astragalus Andersonii* A. Gray, Proc. Am. Acad. **6**: 524. 1866. Watson placed this next to *Astragalus malacus*, where I am inclined to retain it on account of the spreading pubescence of the broad pod. Jones placed it in his section HAMOSI next to *A. Congdoni*. It is true that in certain respects it is intermediate between the MALACAE and the next group.

NEVADA: Carson City, *Anderson 233; Heller 9816;* Empire City, *Jones*, in 1882; Reno, *Stokes*, in 1900; Eagle Valley, *Stretch*, in 1865; Hunter Creek Cañon, *Kennedy 1602;* Kings Cañon, *Baker 906;* Washoe County, *Heller 9768; Kennedy 2084; Watson 258;* Verdi, *Stokes*, in 1903.—CALIFORNIA: *Lemmon 64;* Inyo County, Heller *8357;* Lone Pine, *Jones*, in 1897; Sierra Valley, *Lemmon 1089, 630;* Independence, *Matthews*, in 1877; Lassen Co., *Eggleston 6734, 6730*.

3. SCAPOSAE

This group is characterized by the scapose habit, the silvery leaves, the short broad pod, and the broad, more or less 2-lobed wing-petals, the corolla in this respect resembling that of *Aragallus*.

Calyx-teeth subulate-lanceolate, more than half as long as the tube ..... 6. *H. calycosa*

Calyx-teeth deltoid-lanceolate, about one-third as long as the tube.

Leaflets 3–9, oval or obovate, 5–12 mm. long, inflorescence several-flowered ..... 7. *H. scaposa*

Leaflets 7–11, oblong-oblanceolate, 3–4 mm. long, inflorescence 1–3-flowered, rarely 4-flowered.. 8. *H. manca*

6. HAMOSA CALYCOSA (Torr.) Rydb. This species was described as having ochroleucous flowers, only the keel being tipped with purple. This is apparently usually the case in the Nevada and California specimens. In the Wyoming, Idaho and Utah specimens the corolla is usually larger and often wholly purplish: this form was described as *Astragalus brevicaulis* A. Nels.

CALIFORNIA: Inyo Mountains, *Coville & Funston 1780.*—NEVADA: East Humboldt Mountains, *Watson 257;* Koalin Hills, *Stretch 267;* Mineral County, *Heller 10494;* Palmetto Range, *Purpus 5872.*—UTAH: Jugtown, Piute County, *Jones 5403;* Eureka, *Jones*, in 1891; Deep Creek and Detroit, *Jones;* Ephraim, *Tidestrom 1125;* Manti Forest, *Clos 6;* Loa, *Jones 5639j;* Salina Cañon, *5422, 5413a, 5412h;* Milford, *Stokes*, in 1903; Tintic, *Wooton*, in 1915; Ephraim, *Eggleston 10118.*—WYOMING: Fort Bridger, *A. Nelson 4601.*—IDAHO: Pocatello, *Mrs. Soth 44; Palmer 45; Macbride & Payson 3107.*

7. HAMOSA SCAPOSA (A. Gray) Rydb. This species is closely related to the preceding. Jones, perhaps correctly, regards it as a variety thereof. It is a larger plant, with more elongate inflorescence and short calyx-teeth. The corolla is usually purplish. *Astragalus candicans* Greene is a synonym of it.

COLORADO: McElmo Cañon, *Eastwood.*—NEW MEXICO: Aztec, *Baker 409;* Socorro, *Plank*, in 1895.—ARIZONA: *Palmer 100, 109;* Hell's Cañon, *Rusby 580;* Fort Huachuca, *Wilcox*, in 1893; Grand Cañon, *Miss Beckwith 92;* Fort Verde, *Mearns 297*, in 1888; Hackberry *Jones 4426;* Peach Springs, *Jones 63; Lemmon 3252;* Grand Cañon, *Macbride & Payson 944; Grant 74a;* Jerome Junction, *Tidestrom 897;* Oak Creek, *Purpus 8240;* Black Rock Spring, *Jones 5098n;* Pagumpa, *5098a.*—NEVADA: Pioche, *Maud Minthorn 10.*

8. **Hamosa manca** Rydb. sp. nov. Acaulescent tufted, cespitose perennial, with a short woody caudex; stems less than 1 cm. long; leaves 1.5–2 cm. long; stipules deltoid, 2 mm. long; leaflets 6–11, elliptic-oblanceolate, 2–4 mm. long, 1–2 mm. wide, acute or obtusish; silvery-canescent; peduncles slender, 2–5 cm. long; racemes 1- or 2- (rarely 3-) flowered; bracts

lanceolate, 1 mm. long; calyx campanulate, silvery-strigose, the tube 3–4 mm. long, the teeth deltoid, 1 mm. long; corolla about 1 cm. long, ochroleucous, the keel tipped with purple; banner broadly obovate, deeply notched; wings of about the same length, broad, 2-lobed at the apex; keel-petals broadly lunate, rounded at the apex; pod oblong-ovate, about 1 cm. long, and 4 mm. wide, sericeous.

Type collected in Clover Mountains, Nevada, near Death, July 24, 1908, *Heller 9163* (herb. N. Y. Bot. Gard.); apparently also in Charleston Mountains, Clark County, *Heller 11032*.

4. Tricarinatae

This group constitutes also a part of Gray's section *Micranthi* of *Astragalus* and Sheldon's *Eremiticus*. It could be said to be equivalent to the main part of Jones' section *Hamosi*. Jones' name should not be adopted, however, for evidently it was taken from *Astragalus hamosus* L., a European species, which is an annual and has an almost terete and thick-walled pod, and belongs to a group not represented in America. Jones' section is also unnatural, comprising species of widely different affinities, as *A. distortus* and *A. Engelmanni* without any septum (Jones' illustration of the cross-section of the pod of the former is faulty); *A. glaber*, related to *A. Leibergii; A. Orcuttianus*, *A. Howellii*, *A. misellus*, *A. Nevisii*, and *A. Traskiae*, which constitute a group related to what Jones called *Galigiformes;* and *A. Mulfordi*, whose nearest American relative is *A. Bolanderi*.

The group is characterized by the perennial root, crowned by a cespitose, more or less woody caudex, leafy stems, comparatively short calyx-tube, usually middle-sized corollas (8–15 mm. long), linear or narrowly oblong pod, which is glabrous or striate, more or less arcuate, sessile (or if stipitate, articulate to the minute stipe, which therefore is a prolongation of the receptacle, not of the pod), more or less compressed, cordate in cross-section, sulcate but not deeply so on the lower suture, and with a complete or nearly complete septum.

Calyx more or less black-hairy.
Pod glabrous.
Stem and leaves glabrous or nearly so..... 9. *H. umbratica*
Stem and leaves pubescent.
Pubescence appressed; leaflets oblong.
Stem slender; leaflets strigose on both sides; corolla about 8 mm. long..... 10. *H. bernadina*

Stem stout; leaflets white silvery above; corolla 15–16 cm. long..... 11. *H. tricarinata*
Pubescence spreading, leaflets obovate, retuse..... 12. *H. Greggii*
Pod strigose; plant distinctly pubescent.
Leaves and stem villous; pod acuminate, 15–16 mm. long.
Corolla white or pale; pod reflexed-spreading; stems tall erect..... 13. *H. Congdoni*
Corolla dark purple; pod erect; stem low, decumbent..... 14. *H. Gooddingii*
Leaves strigose beneath, glabrate above.
Stem 1–2 dm. high; stipules large, broadly ovate, scarious; pod firm..... 15. *H. ensiformis*
Stem 3–5 dm. high; stipules small, subulate to deltoid; pod thin walled.
Corolla 8–10 mm. long, purple veined; leaflets obovate, scarcely notched..... 16. *H. drepanoloba*
Corolla 7–8 mm. long, white; leaflets ovate or oval, deeply notched. 17. *H. Paysonii*
Calyx white-hairy.
Leaves silky-canescent on both sides, keel not acuminate.
Leaflets 7–11, oval-obovate, rounded at the apex; corolla purple..... 18. *H. albens*
Leaflets 9–19, linear or oblong, acute or obtuse; corolla white or nearly margined with purple.
Leaflets 9–15, linear, more than 1 cm. long..... 19. *H. arizonica*
Leaflets 15–19, oblong, 5–8 mm. long.... 20. *H. Coahuilae*
Leaflets glabrate above; keel acuminate..... 39. *H. nothoxys*

9. **Hamosa umbratica** (Sheldon) Rydb. *Astragalus sylvaticus* S. Wats. Proc. Am. Acad. **23**: 262. 1888. Not *A. sylvaticus* Willd. *Astragalus umbraticus* Sheld. Minn. Bot. Stud. **1**: 23. 1894. This is characterized by being glabrous even as to its pod.

OREGON: Glendale, *Howell 674*, in 1887; *Henderson 1342;* Muriel, *J. C. Nelson 1393;* Josephine County, *Peck*, in 1918.—CALIFORNIA: Humboldt County, *Mrs. Manning 181; Rattan*, in 1883; *Joseph P. Tracy 4598, 4575*.

10. **Hamosa bernadina** (M. E. Jones) Rydb. *Astragalus bernadinus* M. E. Jones, Proc. Calif. Acad. II. **5**: 661. 1895. This species is related to *H. Congdoni* and *H. arizonica*, but

differs from both in the glabrous pod, from the former in the strigose pubescence, and from the latter in the broader leaflets and the black-hairy calyx. It differs from *H. tricarinata* in the slender habit, much smaller flowers, and the leaflets not being silvery beneath.

CALIFORNIA: San Bernadino Mountains; *Parish 2581;* Jucumba, *Eggleston 19724;* Coronado Forest *19821, 19836;* Ashberry Range, Sta. Cruz County, *19840.*

11. **Hamosa tricarinata** (A. Gray) Rydb. *Astragalus tricarinatus* A. Gray, Proc. Am. Acad. **12:** 56. 1876. This is characterized by the stout habit, large flowers, and leaves silvery beneath.

CALIFORNIA: 'Southern California,' *Parry & Lemmon 88;* White Water, *Parry 2;* San Bernadino, *Parish 92;* Coyote Cañon, *H. M. Hall 2858;* Jucumba; *Eggleston 19724.*

12. **Hamosa Greggii** (S. Wats.) Rydb. *Astragalus Greggii* S. Wats. Proc. Am. Acad. **17:** 343. 1882. This is not closely related to any of the other species of the group, as the pubescence is spreading and the leaflets are broad and retuse at the apex. Jones placed the species in his Micranthi, but at the same time compared it with *Astragalus Lindheimeri* and *A. Nuttallianus.* The pod however, places the plant in the TRICARINATAE.

COAHUILA: Saltillo, *Palmer 258,* in 1880.

13. **Hamosa Congdoni** (S. Wats.) Rydb. *Astragalus Congdoni* S. Wats. Proc. Am. Acad. **20:** 360. 1885. This species differs from the other species of the group in its villous pubescence, long and lax racemes, large white flowers, and rather narrow calyx-tube.

CALIFORNIA: Mariposa County, *Congdon* in 1883, 1892, and 1893.

14. **Hamosa Gooddingii** Rydb. sp. nov. Perennial, with a cespitose caudex; stems decumbent, about 1 dm. high, strigose; leaves spreading, 2–3 cm. long; stipules ovate, 2–3 mm. long; leaflets 9–13, obovate to elliptic, rounded or obtuse at the apex, 3–5 mm. long, 2–3 mm. wide, glabrous above, strigose beneath; peduncles 7–10 cm. long, strigose, arcuate; raceme 2–4 cm. long; bracts 2 mm. long, lanceolate; calyx strigose with mixed black and white hairs, the tube 4 mm. long, the teeth subulate, 2 mm. long; corolla dark, bluish-purple, about 1 cm. long; banner obovate, retuse; wings shorter, the blades oblong-falcate, with a broad basal auricle; keel-petals much shorter, the blade

broadly lunate, strongly arched, rounded at the apex; pod lance-linear, 1.5–2 cm. long, 3 mm. high and broad, somewhat falcate, minutely strigose or in age glabrate, deeply cordate in cross section, membranous.

Type collected on rocky slope in the Huachuca Mountains, Arizona, May, 1912, *Gooding 1299* (herb. N. Y. Bot. Gard.).

15. **Hamosa ensiformis** (M. E. Jones) Rydberg. *Astragalus ensiformis* M. E. Jones, Proc. Calif. Acad. II. **5**: 658. 1895. Though I have placed this species next to *H. drepanoloba* and *H. Paysonii*, it is not closely related to either, differing in the firm pod and leaves, the low habit and the large scarious stipules. The corolla is unknown. Jones first described it under *Astragalus ursinus*, stating that the 'flowers seem to be identical with those of *arietinus*, but paler.' The type sheet, now at Pomona College, has no flowers. It is known only from the type collection from Pagumpa, Ariz., *Jones 5095ah*.

16. **Hamosa drepanoloba** (A. Gray) Rydb. *Astragalus drepanolobus* A. Gray, Proc. Am. Acad. **19**: 75. 1883. This resembles much *H. umbratica* in leaf-form and somewhat in general habit, but the stems are decumbent and strigose, the leaflets are glabrous above, strigose beneath and the pod is almost papery and finely strigose. The corolla is evidently pale-purple when fresh, with the banner decidedly purple-veined, but soon fades and becomes almost white.

Hooker in his Flora Boreali Americana described a species *Astragalus diaphanus* from specimens collected by Douglas at the Great Falls of Columbia. This was unknown to Gray when he wrote his revision but he stated: 'I learn that the plant has the aspect of *A. distortus*,' which is the case with *H. drepanoloba*. It was also unknown to Watson, but in his Bibliographical Index, he made it a synonym of *Astragalus lentiginosus* Dougl. Sheldon simply admitted it as a species without any remarks. Piper made it a questionable synonym, and it is indeed very questionable if referred to *A. lentiginosus*. Jones (Proc. Calif. Acad. II. **5**: 675. 1895) made it a variety of *A. lentiginosus*, apparently without ever having seen any specimens agreeing with Hooker's description. There is nothing in that description except the number of leaflets (5–9 pairs in Hooker's description, and usually 4–5, rarely 6 pairs in *H. drepanoloba* as far as known), which does not fully agree with *H. drepanoloba*. I

suspect that *A. diaphanus* is the oldest name for this species. Stretch's specimen is less pubescent, more slender and low-stemmed, but cannot be separated specifically. Jones determined this as *A. iodanthus*, to which it evidently does not belong.

WASHINGTON: Bingen, *Suksdorf 7726.*—OREGON: John Day River, *Howell*, in 1882 and 1885.—NEVADA: Washoe Valley, *Stretch 265*.

17. **Hamosa Paysonii** Rydb. sp. nov. Perennial, with a woody caudex; stems many about 5 dm. high, glabrous or nearly so, striate, light-green; leaves ascending, 7–10 cm. long; stipules deltoid, 3–4 mm. long; leaflets ovate or oval, deeply notched at the apex, 10–17 mm. long, 4–10 mm. wide, glabrous above, strigose beneath; peduncles 5–10 cm. long, erect, racemes 4–5 cm. long; bracts lance-subulate, 2 mm. long or less; calyx black-hairy, the tube 2.5–3 mm. long, the teeth subulate, 2 mm. long; corolla white, 6–8 mm. long; banner obovate, rather abruptly arched; wings shorter, the blade rather broad, elliptic; keel-petals shorter, broadly lunate, rounded at the end; pod (immature) oblong, tapering at each end, 2 cm. long, 3 mm. broad and thick, strigose, the cross-section somewhat obcordate.

Type collected at Horse Creek, seven miles west of Merna, Sublette County, Wyoming, *Payson & Payson 2748* (herb. N. Y. Bot. Gard.).

18. **Hamosa albens** (Greene) Rydb. *Astragalus albens* Greene, Bull. Calif. Acad. **1**: 156. 1885. This is related to *H. arizonica*, but differs in the more slender decumbent stems, the smaller flowers, shorter peduncles, and broader leaves. Jones (Rev. Astrag. 261. 1923) described the pod as 'arched mostly to a circle, . . . when mature coriaceous, strongly corrugated, 2–3 cm. long, 3 mm. wide and high, flat for about 1 mm. high along the ventral suture and forming a thick wing, etc.' In the type number the pod is only 1.5 cm. long, forming an arch of about one fourth of a circle, neither coriaceous nor corrugated. The rest of the description is unintelligible to me

CALIFORNIA: Mojave Desert, *Parish 1274;* Colorado Desert, *Eastwood 2690.*

19. **Hamosa arizonica** (A. Gray) Rydb. *Astragalus arizonicus* A. Gray, Proc. Am. Acad. **7**: 398. 1868. This is characterized by the narrow, usually linear, white-strigose leaflets.

ARIZONA: *Palmer 591, 100*, in 1876; Bishop Creek; *Mearns 350;* Camp Grant, *Palmer 53*, in 1867; Skull Valley, *Jones*, in

1903; Calabasas, *Tidestrom 865;* Tucson, *Griffiths 3542;* Mescal Mountains, *Jones*, in 1890; Oracle, *Griffiths 3730; Patagonia, Tidestrom 818;* Santa Rita Forest, *Griffiths 3804;* Skull Valley, in 1903; Little Colorado, *Ward*, in 1901; Apache, *Eggleston 19851;* Crook Forest, *19898;* Fort Grant, *19932;* Klondyke, *19938.*—SONORA: Tubac, *Parry* in *Mexican Boundary Survey 267;* Los Nogales, *E. K. Smith.*—NEW MEXICO: Aztec, *Baker 417;* Fort Wingate, *Matthews.*

20. **Hamosa Coahuilae** (M. E. Jones) Rydb. *Astragalus Coahuilae* M. E. Jones, Rev. Astrag. 256. 1923. This is related to the preceding, but is erect, much branched, grayish canescent with short kinked hairs, the pods are smaller and strongly ascending. Jones in his key compares it with *Astragalus glaber*, to which it has no close relationship. Earlier he had determined Palmer's specimens as *A. nothoxys*, to which it is closely related, but the pubescence is different and the keel not beaked.

COAHUILA: Parras, *Palmer 234; Purpus 4672.*

Four new Melastomataceae from Peru

H. A. Gleason

Among the collections of Dr. Francis W. Pennell, made in Peru, Bolivia, and Chile in 1925, the following undescribed species appear. While the types are in each case in the herbarium of the New York Botanical Garden, duplicates of the same collection numbers are in the Gray Herbarium of Harvard University, the herbarium of the Field Museum of Natural History, and the herbarium of the Academy of Natural Sciences of Philadelphia. The duplicates have not been examined by the author.

Brachyotum nutans n. sp. Stems shrubby, the bark exfoliating on the older parts; young twigs sparsely appressed-setose and with a ring of erect setae at each node, becoming glabrous with age; petioles 2–3 mm. long, usually with 2 or 3 appressed setae; leaf-blades ovate-oblong, thick, dark green above, yellowish-green beneath, 8–12 mm. long, 4–6 mm. wide, rounded at base and apex, conspicuously setose-ciliate on the recurved margins, glabrous and somewhat rugose above, glabrous on the surface, sparsely appressed-setose on the veins, and prominently dark-punctate beneath; principal veins 3, somewhat saccately confluent at base, veinlets obsolete; floriferous branches from the upper axils, about 1 cm. long, erect, bearing a single pair of reduced leaves and a nodding terminal peduncle 5 mm. long; flowers 4-merous; hypanthium broadly campanulate, 4–4.5 mm. long to the staminal torus, 4.5 mm. in diameter, glabrous or sparsely appressed-setose; calyx-limb prolonged 1 mm. beyond the torus, the sepalar sinuses paraboloid, entire, 1 mm. deep and wide, with an erect basal seta; sepals triangular, 4.7 mm. long, 4.3 mm. wide, acute, setose-ciliate, somewhat carinate; corolla royal purple, the petals 19 mm. long, finely ciliate, reticulately veined, the exposed side semi-ovate, 7 mm. wide, the concealed side semi-rhomboid, 8 mm. wide, with an obtuse lateral lobe; filaments stout, somewhat flattened, 3.5 mm. long, 0.8 mm. wide; anthers nearly straight, lance-elliptic, blunt, 3.5 mm. long, 1.2 mm. wide, the connective with a minute dorsal protuberance at base and two anterior callosities 0.3 mm. long; ovary 4-celled, ellipsoid, 4.7 mm. long, somewhat 4-lobed, the terminal lobes broadly deltoid, blunt, 0.5 mm. long, pilose with straight erect hairs; style slender, straight, 26 mm. long; stigma slightly clavate, blunt, 0.5 mm. in diameter, minutely pilose.

Type, *Pennell 13,847*, collected on open grassy paramo, Paso de Tres Cruces, Cerro de Cusilluyoc, Dept. Cuzco, Peru, 3 May

1925, and deposited in the herbarium of the New York Botanical Garden. *Brachyotum nutans* belongs to the 4-merous group of the section *Adesmiae*, in which only five species have been hitherto described. Of these, only *B. alpinum* Cogn. has leaves glabrous above. It differs from ours in the densely pilose twigs, nodes, petioles, lower leaf-surface, and hypanthium, in the leaves acute at base and with developed veinlets, in the relatively shorter and more pilose sepals, and in the much shorter petals. The heavy development of pubescence on *B. alpinum* gives it quite a different general aspect.

Cogniaux erected the section *Octomeris* of the genus *Tibouchina* to include the single species *T. octopetala* Cogn., based on a collection by Rusby in Bolivia, the type of which is conserved in the herbarium of Columbia College at the New York Botanical Garden. A recent collection by Pennell, numbered *14,039*, now extends its range into Peru. It agrees in every essential respect with the type, differing only in minor details of the pubescence. Another collection by Pennell, numbered *13,971*, from the same general locality and altitude, represents a new 8-merous species and differs notably in several important features.

Tibouchina pulcherrima n. sp. Stems shrubby, the upper branches obscurely quadrangular, densely clothed with an indument of short, curved, red-purple, flexuous hairs, the larger internodes 10–15 cm. long; petioles stout, 20–25 mm. long, densely short-hirsute with red-purple hairs; leaf-blades firm, narrowly ovate-oblong, 15–18 cm. long, 6–7.5 cm. wide, long-acuminate, obtuse at base, setose-ciliate, 5-nerved, with an additional pair of faint marginal nerves, upper surface velvety green, densely covered with short, stout, conic tubercles, somewhat thickened at the obscure angles and terminated by a short, ascending, subulate seta, lower surface cinereous, each areole deeply foveolate, the veinlets marked by straight, whitish, spreading hairs 0.5 mm. long, first and fifth veins arising from the second and fourth 1–2 cm. above the base, the principal veins and secondaries marked by dense pubescence of purple-red, ascending, subulate, minutely plumose hairs nearly 2 mm. long; inflorescence terminal, few-flowered, the peduncles 5 cm., the pedicels 10–15 mm. long; bracts obovate, 10 mm. long, 8 mm. wide, broadly rounded at summit, setose-ciliate, densely hirsute on the back; flowers 8-merous; hypanthium broadly subcylindric, 7 mm. long to the staminal torus, 16-nerved on the inside, densely hirsute with purple curved-ascending setae

nearly 2 mm. long; calyx-limb 1.6 mm. long; sepals oblong, 6 mm. long, 2 mm. wide, narrowed from the middle to an acute tip, many-nerved, setose-ciliate, densely purple-hirsute on the back; petals cuneate-obovate, 13 mm. long, 10 mm. wide, broadly truncate, finely ciliate; filaments somewhat flattened at base, glabrous, 6.5–7 or 7.5–8 mm. long; anthers linear-subulate, glabrous, 5.5–6 or 7.5–8 mm. long, opening by a single terminal pore; connective of the short stamens scarcely prolonged, appendaged anteriorly by 2 obliquely ovoid, nearly erect processes 1 mm. long and minutely gibbous dorsally; connective of the long stamens prolonged 1–1.5 mm. at right angles to the anther, its appendages nearly erect, 1.3 mm. long; ovary free, 4-celled, short-ovoid, 8 mm. long, erect-setose on the distal fourth, prolonged at the summit into 8 blunt ovoid lobes 0.7 mm. long; style stout, terete, 10 mm. long, conspicuously hirsute below; stigma capitate, barely expanded, 1.2 mm. in diameter.

Type, *Pennell 13,971*, collected in forest, 'Pillahuata,' Cerro de Cusilluyoc, Dept. Cuzco, Peru, alt. 2200–2400 m., 3–6 May 1925, and deposited in the herbarium of the New York Botanical Garden. *T. pulcherrima* differs from *T. octopetala* Cogn. in its conspicuously purple, shorter indument, in its much longer and proportionately narrower leaves, in its beautifully purpled veins and conspicuous secondaries, in details of its leaf-pubescence, in its long peduncles and pedicels, producing an open inflorescence, in its shorter filaments, and its erect basal lobes of the connectives.

Tibouchina dimorphylla n. sp. Fruticose; upper branches sharply 4-angled with channeled sides, thinly pubescent with short, spreading, more or less flexuous hairs, the larger internodes 16 cm. long; principal leaves on petioles 3–4 cm. long and densely pubescent, the blades ovate-oblong, acute, minutely denticulate with setiferous teeth, rounded at base, 18 cm. long, 7 cm. wide, 5-nerved, the upper surface bullate and sparsely hirsute with subappressed subulate setae 1 mm. long, the lower surface foveolate, thinly pubescent on the veinlets with short white hairs 0.2–0.4 mm. long, and more densely pubescent on the nerves with stout hairs 0.4–0.8 mm. long, outer nerves arising from the intermediates 2–5 mm. above the base; leaves subtending the floriferous branches with petioles 8–15 mm. long, the blades cordate-ovate, 6.5–10 cm. long, acute or subacuminate, distinctly cordate at base, irregularly 5–7-nerved, the lamina arising at the junction of the outer and intermediate nerves; uppermost leaves 3–4 cm. long; inflorescence compact, few-flowered, on densely pubescent peduncles 3–5 cm. long; pedicels 3–12 mm. long; flowers 5-merous; hypanthium sub-

globose, 5 mm. high, densely hispid with curved-ascending, subulate hairs 1 mm. long, obscurely 10-nerved, calyx prolonged 0.6 mm. beyond the staminal torus, its sinuses broadly rotund; sepals 5 mm. long, triangular-deltoid at base, the free tip linear, obtuse, hispid like the hypanthium; petals ovate, violet, 10–12 mm. long, finely ciliate at base and apex, tipped with a seta 1 mm. long; filaments essentially terete, 5.2 or 5.9–6.3 mm. long, glabrous; anthers subulate, 4 or 4.8–5 mm. long; connective bent introrsely and prolonged about 1 mm. in the larger stamens, minutely gibbous on the back, extended anteriorly into 2 truncate appendages 0.5 mm. long and 1 mm. wide; ovary free, subhemispheric, 4 mm. high, hispid on the upper two-thirds, obscurely 5-lobed, each lobe tipped with a fleshy, glabrous, truncate protuberance 0.5 mm. long and 1 mm. wide; style stout, terete, 10 mm. long; stigma capitate, scarcely expanded.

Type, *Pennell 14,109*, collected in a thicket in a valley on the paramo above 'Pillahuata,' Cerro de Cusilluyoc, Dept. Cuzco, Peru, alt. 3000–3300 m., 3–6 May 1925, and deposited in the herbarium of the New York Botanical Garden. It is a member of the group numbered 120–122 in Cogniaux' Monograph, including *T. Rusbyi* Cogn., *T. mollis* (Bonpl.) Cogn., *T. Solmsii* Cogn., *T. adenophora* Cogn., *T. cymosa* Cogn., and *T. rhynchantherifolia* Cogn. Of these, it is most closely similar to the well known *T. mollis*, from which it differs in its larger leaves on longer petioles, conspicuously thinner leaf-pubescence, longer peduncles and pedicels, small and few-flowered inflorescence, and sparser pubescence on the hypanthium.

In *Pennell 14,092*, collected at the same locality, the inflorescence is larger, the upper cordate leaves are smaller, the internodes are shorter, and the hypanthium and sepals are smaller. It seems to agree with the type in every respect except dimensions, and I tentatively refer it to the same species.

Axinaea Pennellii n. sp. Arborescent, leaf-buds and undeveloped internodes densely ochraceous-furfuraceous with branched hairs, the older parts soon becoming glabrous; younger twigs irregularly and obtusely 4-angled, the older subterete; nodes conspicuously tumid and marked with an annular scar; petioles thinly furfuraceous, 18–22 mm. long; leaf-blades firm, dark dull green above, yellow-green beneath, ovate-oblong, 10–16 cm. long, 3.5–6 cm. wide, the members of each pair slightly unequal, long-acuminate to a narrow but blunt, rounded tip, conspicuously denticulate with low (about 1 mm.), remote (about 5 mm. apart), blunt teeth, cordate at base, the basal lobes and 5–10 mm. of the margin reflexed and overlapping

on the lower side and connate on the upper side into a small tubercle, glabrous and inconspicuously reticulate above, thinly furfuraceous on the surface, more densely so along the veins, and obscurely reticulate beneath; principal nerves 5, with an additional pair of weak marginal nerves; secondary nerves arising at an angle of about 80°, 2–3 mm. apart; inflorescence terminal, about 10-flowered; pedicels sparsely furfuraceous, 5–10 mm. long; flowers 5-merous; hypanthium (including the limb) broadly hemispheric 5 mm. high, 8 mm. broad, glabrous or rarely a trifle furfuraceous, the limb entire, prolonged 2 mm. beyond the staminal torus; petals purple, fleshy, broadly oblong-elliptic, 20 mm. long by 12 mm. wide, obtuse or rounded, glabrous; stamens slightly unequal; filaments stout, fleshy, flattened, 8 or 10 mm. long, 2 mm. wide, glabrous; anthers stoutly subulate, 6 or 8 mm. long, minutely 1-pored; connective inflated posteriorly, ovoid, 5–6 mm. long by 3–4 mm. in diameter; ovary 4 mm. high, obscurely 5-ridged, prolonged at summit into 5 short obtuse lobes; style terete, slightly tapering, somewhat bent, 14 mm. long; stigma minute, truncate.

Type, *Pennell 14,003*, collected on a forested cliff above Rio Pillahuata, Dept. Cuzco, Peru, 3–6 May 1925, and deposited in the herbarium of the New York Botanical Garden. It differs from the other members of the group, seven in number, in its larger and proportionately narrower leaves, much larger flowers, the thinly furfuraceous indument, and the conspicuously reflexed basal lobes of the leaves. Its nearest relative is *A. Weberbaueri* Cogn.

Notes on Mielichhoferia

EDWIN B. BARTRAM

(WITH TWENTY TEXT FIGURES)

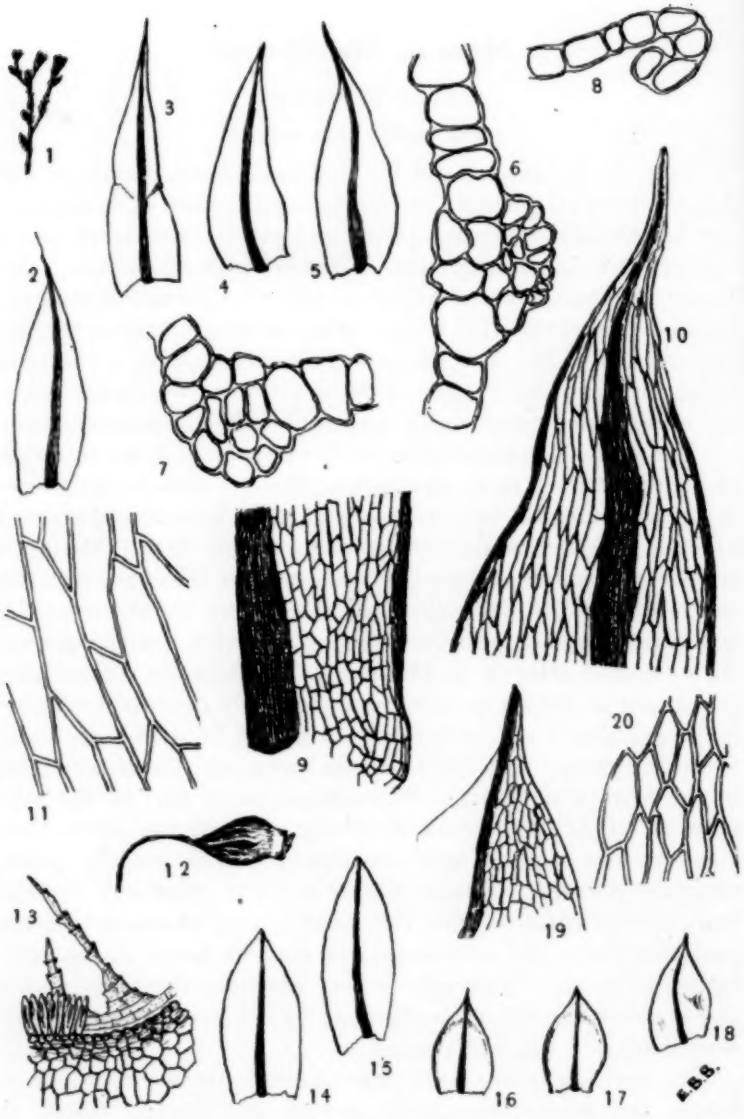
Prof. A. O. Garrett and his Boy Scout associates from Salt Lake City were engaged in the laudable effort of broadening our knowledge of the moss flora of Utah by field work in the vicinity of their summer camp in the Wasatch Mountains, Utah County, during July and August of 1925. A portion of their collections was transmitted to the writer for determination through the courtesy of Mr. A. T. Beals and in this lot occurs a gathering representing a new variety of *M. macrocarpa* which has led to some suggestive comparisons that are briefly summarized below.

The genus *Mielichhoferia* is richly represented in the cordillera of South America, more sparingly in Mexico, while in the United States and Canada only two species have been recorded, both of them rare and practically confined to the Rocky Mountain region. These two species, *M. macrocarpa* (Hooker) Bruch & Schimper and *M. cuspidifera* Kindberg, are clearly separable from the European group, comprising *M. nitida* Hornschuch and *M. compacta* (Hoppe & Hornsch.) Kindberg, in the usually percurrent or even excurrent costa, the nearly entire leaf margins, and especially in the relatively thin walled, lax leaf cells, which contrast strongly with the yellowish incrassate, linear areolation of the European plants. An examination of part of the type material of *M. cuspidifera* Kindberg confirms the distinctions given in the original brief description.[1] The broadly ovate, abruptly pointed, concave leaves and the relatively broader and shorter leaf cells give the plant a very characteristic appearance under the microscope, as may be noted in the text-figures 16 to 20. Although known only from the type locality and in sterile condition the plant can hardly be considered otherwise than as a distinct species.

M. macrocarpa has been characterized by the more obtuse leaves and innovations more clavate and densely foliate in relation to *M. nitida*, to which it was at one time appended as a variety.[2] In Drummond's Musci Americani no. 74, upon

[1] Macoun & Kindberg. Catalogue of Canadian plants, part 6: 110. 1892.

[2] Carl Müller. Syn. Musc. Frond. 1: 235. 1849.



FIGS. 1–13. MIELICHHOFERIA MACROCARPA PUNGENS Bartram. FIG. 1. Male plant × 1. FIGS. 2–5. Leaves × 20. FIG. 6. Cross section from lower half of costa × 300. FIG. 7. Cross section from upper half of costa × 300. FIG. 8. Cross section of leaf margin × 300. FIG. 9. One side of leaf base × 100. FIG. 10. Apex of leaf × 100. FIG. 11. Median leaf cells × 300. FIG. 12. Dry, partially deoperculate capsule × 8. FIG. 13. Two peristome teeth × 100.

which this species was based, the flaccid, loosely spreading upper and comal leaves, broadly concave, essentially entire in the acumen and usually costate to the apex, bear little resemblance to the firm, narrowly lanceolate, erect and imbricated leaves of the European species. Specimens from Barclay Island, collected by Dr. Lyall in 1854, agree with the North American forms in the essential characters, and although one tuft is slender with obtusely pointed leaves, and the other short and stunted with more acute leaves, they probably represent variants of *M. macrocarpa* influenced by environmental factors. References to the occurrence of *M. nitida elongata* on Mt. Ktaadn, Maine, in Rhodora **3**: 180, 182, and in the Bryologist **22**: 75, are apparently based on a misconception of the plants collected by Dr. G. G. Kennedy (*no. 2243*) on July 11, 1900, which seem to represent an aberrant form of *Philonotis* sp. A collection from the White Mountains, New Hampshire by C. F. Austin in September, 1872 is the only available record east of the Rocky Mountains, and may be clearly referred to *M. macrocarpa*.

The collections from Utah show a well marked variant of *M. macrocarpa*, which may be designated as *Mielichhoferia macrocarpa* (Hooker) Bruch & Schimper, var. **pungens** var. nov.; it differs from the typical form in the leaves narrowly acuminate, frequently sharply cuspidate, and the leaf margins narrowly recurved from the base nearly to the acumen. Plants densely tufted, about 15 mm. high, yellowish green at the tips, brown and radiculose below, stems slender and brittle, fastigiately branched; leaves erect spreading, rather loosely imbricated and more or less flexuous when dry, ovate lanceolate, gradually tapering to a sharp point, margins narrowly recurved from just above the base nearly to the acumen, essentially entire; costa rather strong, about 50 μ wide at the base, tapering upward, more or less flexuous, percurrent or excurrent into a smooth cuspidate point, in cross section near the base showing several rather poorly differentiated median guide cells with a ventral layer of similar form and a dorsal band of two layers of smaller, thicker walled cells, in the upper half nearly homogenous in

FIGS. 14, 15. MIELICHHOFERIA MACROCARPA (Hooker) Bruch & Schimper. Two leaves from Drummond's Musc. Amer. no. 74.

FIGS. 16–20. MIELICHHOFERIA CUSPIDIFERA Kindberg. FIGS. 16–18. Three leaves × 20. FIG. 19. Apex of leaf × 100. FIG. 20. Median leaf cells × 300

about four layers, but with the cell walls more incrassate on the dorsal side; leaf cells thin walled and almost hyaline, especially in the older leaves, linear-rhomboidal, up to 80 μ long by 13 μ wide, narrower toward the margins, shorter and subrectangular at the base, a few at the extreme angles quadrate and somewhat swollen; seta flexuose, 4 to 5 mm. long, pallid green becoming brown at maturity, neck short and sulcate; operculum flat or very slightly convex and minutely mammillate; peristome single, of 16 pale, linear teeth, widened and confluent at the base, from a short basal membrane; annulus compound, large and persistent; spores about 15 μ in diameter, granulose. Dioicous, male flowers gemmiform and lateral on the stem and branches, antheridia 6 to 8, about 225 μ long with few paraphyses, perigonal bracts numerous, the inner shorter, blunt and loosely areolate. UTAH: Wasatch Mts., Utah Co., cave, near snow above Second Falls, July 29, 1925, *A. O. Garrett 163* (type); dripping limestone cliffs south of First Falls, August 11, 1925, *S. F. Flowers 330;* dripping limestone cliffs by large cave, August 19, 1925, *M. Harris 443;* dry cliffs by large cave, August 18, 1925, *M. Harris 444* and *460.* COLORADO: west of Ouray, canyons and meadows, alt. 2300 to 2800 m., September 9, 1901, *L. M. Underwood and A. D. Selby.*

I wish to express my sincere thanks to Mrs. N. L. Britton for the type material of *M. macrocarpa* and for the specimens from Colorado and Barclay Island; to Dr. Hjalmar Möller of the Naturhistoriska Riksmuseum, Stockholm, Sweden, for the type material of *M. cuspidifera;* and to Prof. J. F. Collins for the specimens from Maine and New Hampshire. The European plants used for comparison are represented by Dr. Bauer's Musci Europaei Exsiccati nos. 901 and 902 from the classic locality near Salzburg.

BUSHKILL, PENNSYLVANIA

Adventitious roots and shoots in an introduced weed

C. L. Wilson

(WITH TWO TEXT FIGURES)

Roripa austriaca Spach, of the family Cruciferae, is a perennial weed recently introduced from Europe. So far, the plant is limited in its distribution. It has been found at Madison, Wisconsin, and within a limited area in Orange County in southern New York, extending across the state line into New Jersey. The writer is indebted to Professor W. C. Muenscher, of Cornell University, for material for the study of vegetative reproduction in this plant, and for information concerning the distribution of the weed.

The term, adventitious, as applied to structures of the plant body, refers in general to any organ produced in an abnormal position on the plant. Roots produced from leaves, roots from stems, and shoots from roots, as well as emergences of various kinds, such as the haustoria of *Cuscuta*, are classified as adventitious structures. Such structures occurring in *Roripa* consist of roots produced on the stem in the axils of branch buds, and of shoots produced upon roots. Adventitious roots are of course produced only upon subterranean stems, or upon aërial stems when these come in contact with soil, as in cultivation. Several roots are ordinarily produced in an axil, three being the usual number. Shoots may be produced almost anywhere upon roots, young or old, especially if these run near the surface of the soil.

According to Van Tieghem (1), adventitious shoots produced upon roots are endogenous in their origin. The term endogenous, in this connection, refers to a method of growth by which a structure in the early stages of development is covered by a layer of tissue of the producing member which does not appear in the formation of the new structure. The production of secondary roots is an example of this. In the production of an adventitious shoot, a number of cells of the pericycle elongate and divide, forming an arc (as seen in section view) of meristematic tissue. By apical growth this tissue pushes its way through the cortex and epidermis.

The writer has found that *Roripa* produces adventitious shoots on roots in a manner which constitutes an exception to this condition. In this plant, adventitious shoots on roots are exogenous. The growing point of the new shoot is formed as a

result of a large number of divisions of cells close to the periphery of the root. In very young roots, this growing point would result from the division of both cortical and epidermal cells. In the root of *Roripa*, however, cork forms at a very early stage. After the formation of cork, the growing point must develop from the continued division of cortical cells just under the cork, resulting in the sloughing off of the cork in front of the protuberance thus formed.

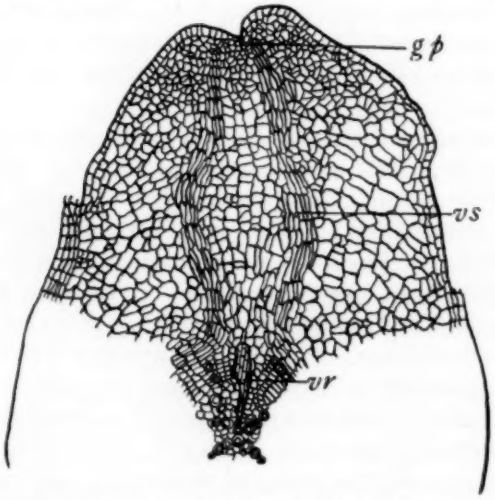


FIG. 1. Cross section of root, showing origin of exogenous shoot. *gp*, growing point of new shoot. *vs*, vascular supply to new shoot. *vr*, portion of vascular supply to a secondary root which is found close to the adventitious shoot. The remainder of the vascular supply to this root is out of the plane of the drawing.

At the same time that the formation of the growing point is going on, a number of cells of the cortex elongate and divide radially. This process extends from the pericycle to the growing point. The tissue takes the form of a cylinder, and constitutes the vascular system of the new shoot. An adventitious shoot of this type usually develops in connection with a secondary root, which appears externally at the side or in the axil of the new shoot. This secondary root may divide several times near the periphery of the root, and appear externally as two or three roots. Figure 1 represents a cross section through a root at the region of formation of an adventitious shoot.

Van Tieghem and Duliot (2) have described the origin of adventitious shoots on roots in *Alliaria officinalis* (Cruciferae). According to these writers, adventitious shoots in this plant are produced endogenously, by the formation of an arc of meristematic tissue from the cells of the pericycle. If the observations of these writers are correct, the condition just described for *Roripa* is not true for all of the Cruciferae. However, such a condition is not entirely exceptional in plants. Van Tieghem (1), in working upon various species of *Linaria*, confirmed the conclusions of previous workers, that the root shoots in this genus are exogenous. The description of the origin of adventitious shoots in *Linaria* sp. accords in all essential details with the description of the same condition in *Roripa*. It is very probable that upon further examination other plants in addition to those just discussed will be found to have adventitious shoots originating in an exogenous manner.

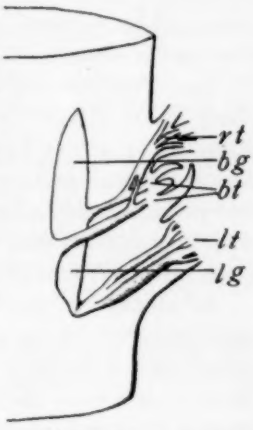


FIG. 2. Nodal anatomy of the stem in a region in which adventitious roots have developed. *rt*, vascular supply to adventitious roots. *bg*, branch gap. *bt*, branch traces. *lt*, leaf traces. *lg*, leaf gap.

Adventitious roots on stems are ordinarily produced in the same manner as secondary roots; that is, endogenously. Roots produced in the axils of branch buds in the Cruciferae are, however, an exception to this general condition. Epidermal and cortical cells in the axil of a normal branch bud divide until a protuberance is formed, the beginning of the new root. While this is going on, cells of the cortex, in a region extending from the branch traces to the growing point of the root, elongate and divide, and form the vascular tissue of the root. The epidermis of the root and stem are continuous, and the root is therefore exogenous. Lemaire (3) discusses this in some detail, although he was not the first to observe this condition. Figure 2 represents a diagrammatic view of the vascular connections of leaf, branch, and adventitious roots as seen in a node of *Roripa*. The leaf traces are five in number. The gap formed by the passing off of the leaf traces merges with the branch gap. As the two

branch traces approach the periphery of the stem, each gives rise to a strand of vascular tissue, just before fusing to form the vascular cylinder of the branch. These strands may quickly unite, and divide again into three parts, each constituting the vascular supply to a rootlet. This is the condition shown in figure 2. There may be variations from this condition. Frequently the branch traces give rise to strands which pass out of the stem without fusing. In such a case, if three rootlets are formed in the axil, the vascular supply of the central one is provided by a branch coming from the vascular supply of one of the lateral roots.

Van Tieghem and Duliot (2) likewise found that endogenous roots are produced by the Cruciferae on the hypocotyledonous stem. The writer has not observed such structures in *Roripa*. Many adventitious roots are found on this portion of the stem, but very probably all are exogenous roots produced in connection with aborted leaf and branch buds. There is no reason to suppose, however, that such roots may not develop.

In conclusion, emphasis may be laid upon the fact that in the root, endogenous and exogenous structures are developed in close connection with each other. Shoots are formed having a different origin from those of the other appendages of the root, but having the same origin as the branch and leaf. On the stem, on the other hand, are developed roots which have the same origin as the branch and leaf. The ability of the roots and shoots of *Roripa austriaca* to develop these adventitious structures so freely, even under adverse conditions, makes it a very serious weed pest. It is thereby enabled not only to propagate and spread but also to persist in spite of vigorous efforts to destroy it.

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INDEX TO AMERICAN BOTANICAL LITERATURE

1925–1926

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in the broadest sense.

Reviews, and papers that relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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